



Asset Management Program Summary 2020

LETTER FROM THE CHIEF OPERATING OFFICER



In a year where nothing happened as expected, Asset Management's value to WAPA far exceeded expectations. Critical data and analyses supplied by the program informed WAPA's adjustment to "the new normal" and ensured that customers continued to receive the same reliable service.

WAPA launched the formal Asset Management program in 2015 to gather data to support reliability-centered maintenance and the 10-year planning process. From a basic "asset inventory" approach—identifying critical equipment and systems and collecting data on their condition—AM processes and reports have evolved to shape WAPA operations beyond maintenance and acquisition decisions. Today, AM reports provide information for planning physical security remediation, developing budgets, analyzing workload and managing vegetation and rights of way.

More than data collection

The role that data now plays in business was evident in the number of projects that drew on Asset Management expertise in 2020. AM was active in several WAPA initiatives that focus on increasing efficiency and effectiveness and controlling costs.

Key among these is Data as a Strategic Asset, an effort to bring a planned, consistent approach to managing WAPA's data. Data as a Strategic Asset is one of six goals in WAPA's streamlined Tactical Action Plan for 2021. Strategies and principles AM developed for asset reporting are providing direction for efficiently collecting, storing, managing and governing data as an asset.

WAPA launched the Workload Planning Initiative in 2020 to develop consistent tools and processes for aligning workloads with existing full-time staff across Operations and Maintenance work and capital projects. AM is contributing to the initiative by examining baseline O&M field work to determine the nature of the projects and their demand on staff time.

AM is also developing resource-loaded schedules for larger capital projects to show project duration by individual activity duration and individual personnel hour estimates. The initiative will enable WAPA to better allocate its workforce to meet the changing maintenance and construction needs of an innovative electric utility.

Accurate data, easy to read

Refining reports and finding new ways to share and apply data became increasingly important in 2020 as AM broadened its focus, providing data to serve other business needs. AM implemented the Data Quality Confidence Index pilot in 2020 to develop a framework to standardize, validate and simplify an asset's Health Index—its condition and historical performance data.

Data must also be presented in a way that is easily understood by those outside of AM. Working with WAPA's Information Technology office, AM is transitioning from tabular data in spreadsheets to more visual presentations. AM shared the first of these

enhanced reports this year, with positive feedback from both WAPA business leaders and Maintenance and field crews.

The Regional Reporting Project, completed in 2020, combined various data sources into a cohesive visual report to answer region-specific questions about capital planning and maintenance. The project aligns with the goals of WAPA and the Department of Energy to use data as a strategic asset.

Making tools work harder

Leveraging data and creating new functions in existing reporting tools was a hallmark of AM from the start and continued in 2020. AM collaborated with O&M, Power Marketing, GIS [Geographic Information Systems] and IT to increase the efficiency of platform interfaces and add new functions to WAPA record systems.

GIS added the latest software and developed enhanced processes to aid in protecting and maintaining WAPA infrastructure. Crews in the field are now able to upload inspection data from their mobile devices to the asset record.

New detailed maps are increasing accuracy and timeliness in fire reports, transmission line inspections and aerial patrols. Efforts to make aerial photos and videos more accessible through cloud services will further WAPA's Data as a Strategy initiative.

Data determines consequences

A new consequence-scoring application completed in 2020 increases the efficiency and accuracy of the assessment process that generates risk-based scores for critical system assets. The consequence-scoring application was a component of substantial improvements in AM's approach to consequence assessment. This process systematically calculates the effect of an asset failure on WAPA business and operations, including capital planning, physical security and maintenance. The more consistent, replicable and user-friendly process increases the accuracy of risk analysis.

The improvements included thoroughly documenting the steps in the process, developing the software application to simplify data entry and training stakeholders to use these tools. A series of job aids and brief "how-to" videos were produced to explain the process and demonstrate the consequence-scoring application to new users.

AM portfolio grows

Bringing new asset classes into the management portfolio continues to be a core part of the AM program.

AM began collecting data on load tap changers, transformer bushings, breakers under 100 kilovolts and cranes. Basic data collection on cranes and circuit breakers under 100 kV is complete and equipment use studies are ready to move forward. The more

complex data collection requirements for LTCs and transformer bushings will continue to develop over the next 12 months.

Originally dedicated to the most critical power system equipment and components, the AM portfolio is now expanding to include additional assets that make up WAPA's "infrastructure." Within the last year, AM reports have begun to incorporate data on such equipment as battery chargers, meters, heating and cooling systems, digital radios, communication monitoring equipment and spare transmission components. These asset classes will grow as the information yields insights about potential cost savings and improved reliability.

More success ahead

Asset Management is well positioned to support WAPA's expanding business information needs moving into 2021. The program continues evolving to provide forward-looking, data-validated insights for budget development for operations, maintenance and capital needs.

In five short years, AM has grown in ways both expected and unexpected, becoming an integral part of WAPA operations. The growing reliance on AM analysis is evident in the newly formed Total Capital Committee using it to prioritize capital projects across WAPA's footprint. More visual reports will encourage all WAPA business units to use data for everything from daily decision-making to investment in infrastructure.

What was once innovation is becoming standard business practice. Asset Management will continue to provide data that shapes WAPA's future.



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Chief Operating Officer

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ABOUT ASSET MANAGEMENT

WAPA owns, operates and maintains more than 17,000 circuit miles of transmission lines and approximately 324 substations. These assets, located in widely diverse operating conditions, pose unique, fleetwide asset management challenges. Asset Management meets these challenges with a methodology that can be consistently applied to assets throughout WAPA's 15-state footprint, four distinct regions and one management center.

By identifying risk associated with WAPA's critical systems and equipment and providing data-driven insight on mitigating that risk, AM supports a wide range of efforts that reinforces the resilience and reliability of the grid. The approach combines extensive field knowledge with input from applicable WAPA departments to enhance existing databases, perform analyses and generate reports that inform objective decisions on budget development, capital plans, operations and maintenance practices, financial forecasting and safety and security upgrades.

Objectives

- Integrate all assets into risk-based methodologies to strategically inform capital investments.
- Maximize value of assets.
- Correlate asset maintenance history, health indices and consequence values to drive risk-based decisions.
- Use asset population and performance data to inform best maintenance practices.

Goals:

- Integrate asset health indices and risk scores to drive condition-based and predictive maintenance activities.
- Streamline electronic collection of asset and maintenance data from field crews and operational systems.
- Integrate artificial intelligence into data gathering, validation and analysis.
- Implement full life-cycle management of assets.

ASSET MANAGEMENT PROGRAM TIMELINE

2014

- WAPA launches formal project to stand up AM program.
- Enterprise GIS comes online, 99% Infrastructure mapped, transmission line inspection field software implemented.

2015

- AM project transitions to formal program.
- Infrastructure data review completed.
- First WAPA-wide transmission line inspection data completed.

2016

- Tier 1 assets are added, capturing 56% of WAPA's asset value.
- GIS, inspection and record-keeping software integrated.

2017

- Implemented condition-based Health Index for transmission lines.
- WAPA-wide transmission line inspections were completed using CartoPac software with GIS, the system of record of data. GIS is interfaced with Maximo, supporting transmission line condition and risk.
- Implemented automated data integration from WAPA-wide common oil test program into AM analytics.

2018

- AM joined industrywide initiative to update failure codes.
- WAPA Office of Security and Emergency Management used AM data to categorize Physical Security Remediation Levels for all substations.

2019

- Transformer acquisition process streamlined.
- Current transformers, coupling capacitor voltage transformers, station batteries and network equipment added.
- Transmission line inspection process requirements updated; field inspection software reviewed.

2020

- Load tap changers, breakers under 100 kilovolts, cranes and transformer bushings added, representing significant parts of WAPA capital plan.
- Failure code update completed and implemented.
- Consequence Scoring process overhauled and automated.

GLOSSARY OF AM TERMS

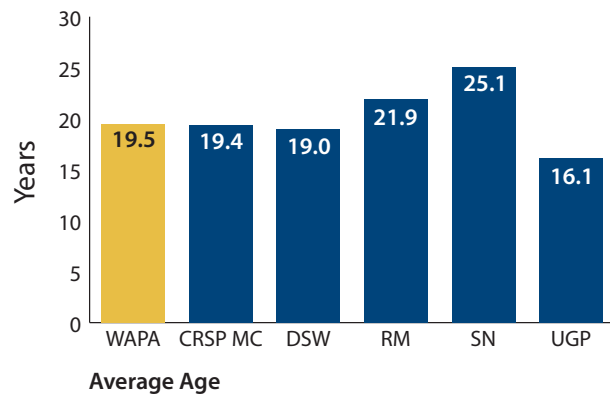
Asset Management or AM	A formal strategy that protects critical physical equipment and systems by collecting data on their condition and performance, and mitigating risk associated with their potential failure.
Asset	Any resource that has potential or actual economic value. The resource may be physical in nature (tangible) or information (intangible) and expressed in terms of cost or other value.
Asset classes	A further division of assets within each asset category. A class may be defined by any accepted distinguishing feature, such as equipment type, location, population, voltage level, current level, power ratings, manufacturer, etc.
Asset risk	The product of probability of failure and the consequence of that failure.
Confidence Index	A framework for evaluating the quality of the data in the AM record-keeping system as it relates to asset health.
Consequence	The identifiable and measurable effect from the failure of an asset.
Consequence analysis	The process of determining the effect of an asset failure (asset unavailable for service) by evaluating consequence, or criticality, factors which measure the relative importance of the asset or asset transmission line system. The analysis yields a score of 0 to 100 with 100 being the most severe effect. The functional groups within WAPA involved in determining consequence of asset failure include Operations, Maintenance, Power Marketing, Energy Marketing, Planning, Transmission Business Unit/Tariff Administration teams and regional Asset Management specialists.
Consequence factors or criticality factors	A series of parameters that identify and measure the effects of an asset's failure. Consequence factors may include monetary and non-monetary consequences. Examples of monetary consequence factors are loss of generation, energy replacement, bypassed water, transmission purchases, contract-liquidated damages, internal regulation/spin replacement, lost merchant transmission resale revenue, curtailed customer load and asset material cost. Non-monetary consequence factors include replacement time, impacts to others, increase in regulatory scrutiny, worsening of reliability or customer relations and damage to brand name.
Critical assets	Facilities, systems and equipment, which if destroyed, degraded or otherwise rendered unavailable, would affect the reliability or operability of the bulk electric system.

Geographical Information System or GIS	Computer system designed to capture, manipulate, analyze, manage and present all types of geographical data. This data is stored in a coordinate system which references a particular place on the earth. GIS systems allow users to create interactive queries, analyze spatial relationships, edit data in maps and present the results of these operations.
Health Index or HI	A composite quantitative measure of asset condition and historical performance that comprises available condition data about the asset such as test results, reliability performance, age, visual inspections, maintenance records, loading, etc. HI is expressed as a score from 0 to 100, with 0 representing near end-of-life and 100 corresponding to a new asset.
Health assessment	An analysis of condition data to determine an asset's HI. The collection of standardized data can be used to optimize maintenance and/or replacement strategies for assets within an asset class.
Health factors	Also referred to as condition parameters, these are characteristics used to assess the asset condition. Examples of condition factors include transformer oil quality, maintenance records, age, loading, etc. Each factor may consist of multiple elements.
Life cycle	The series of changes an asset passes through during its existence. Stages of an asset's life cycle include planning, budgeting, approval/funding, design, construction, commissioning, in-service period and routine maintenance and repair, planned replacement, retirement or de-energization and disposal.
Probability of failure or POF	The statistical likelihood that an asset will not function as designed or expected, cease to function or otherwise become unavailable for service in the next 12 months.
Reliability	Consistent, predictable operation of the bulk electric system.
Reliability-centered maintenance or RCM	The systematic process of optimizing and managing WAPA's major power system asset maintenance with the goal of preserving important power system function.
System asset(s)	Broadly speaking, all capital assets that directly support WAPA's mission to deliver reliable hydropower and related services.

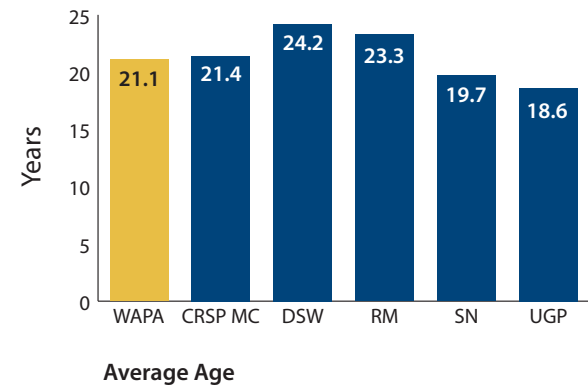
WAPA ASSETS AT A GLANCE

AVERAGE AGE OF ASSETS

Circuit Breakers

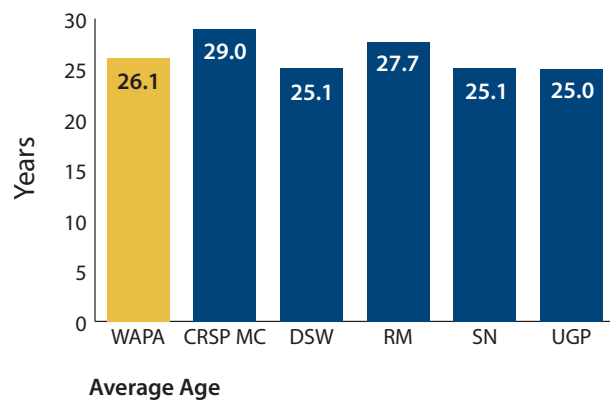


Breakers under 100 kilovolts

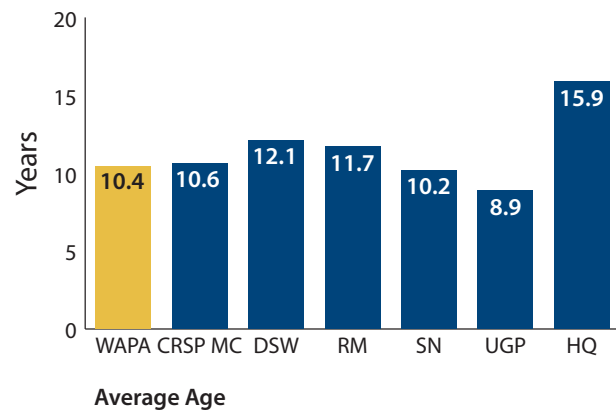


Commentary: Reporting on load tap changers and transformer bushings is expected to begin in 2021.

Transformers

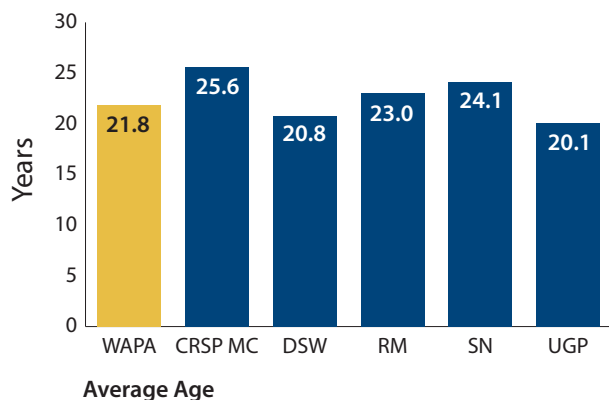


Station Batteries



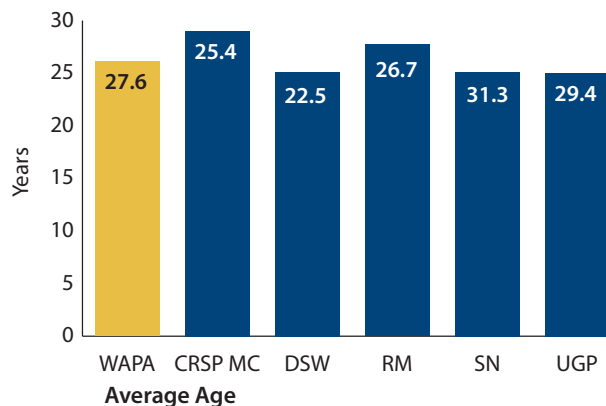
AVERAGE AGE OF ASSETS

Coupling Capacitor Voltage Transformers

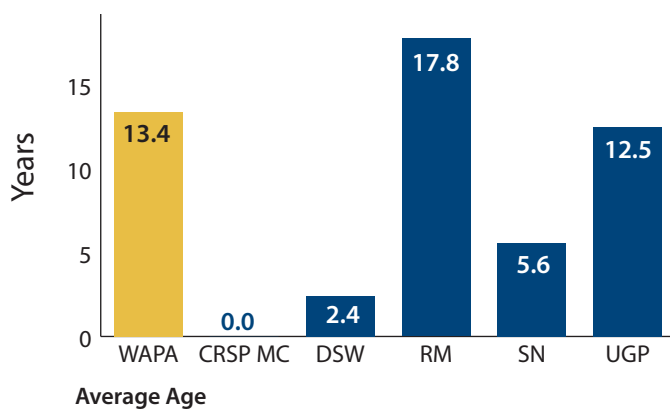


Commentary: CTs, CCVTs and station batteries have different risk and health scores than other assets due to typically short lead times for replacement and the current lack of individual asset health tests.

Current Transformers



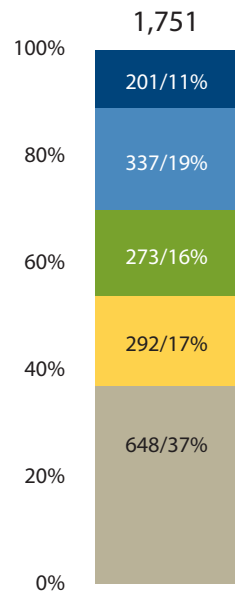
Cranes



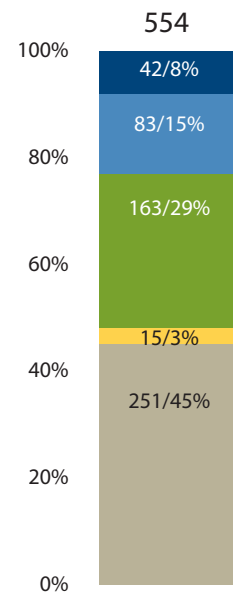
Commentary: CRSP MC assets are maintained by RMR and DSW maintenance organizations requiring no crane assets depicted here.

ASSETS BY REGION

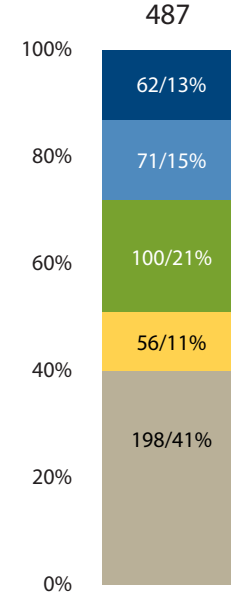
Circuit Breakers



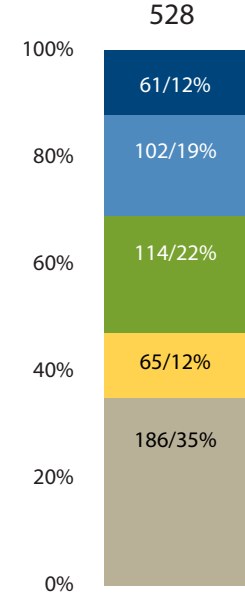
Breakers <100kV



Transformers



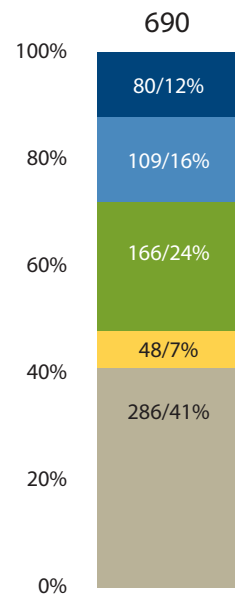
Transmission Line Systems



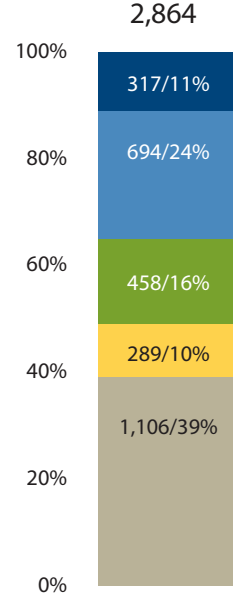
Commentary: Breakers <100kV are not included in the breaker asset class because they receive only Health Index score, rather than point-of-failure, consequence or risk scores. They are routinely monitored for missing data.

Commentary: Single-phase assets are counted as stand-alone when part of a three-phase transformer bank.

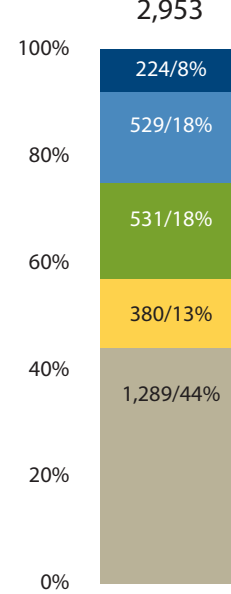
Station Batteries



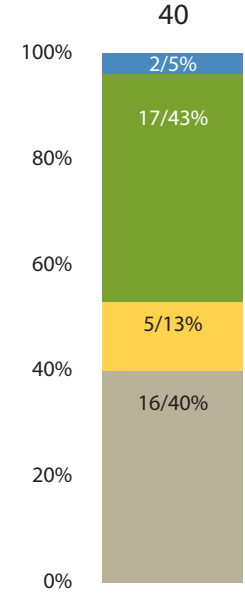
Coupling Capacitor Voltage Transformers



Current Transformers



Cranes

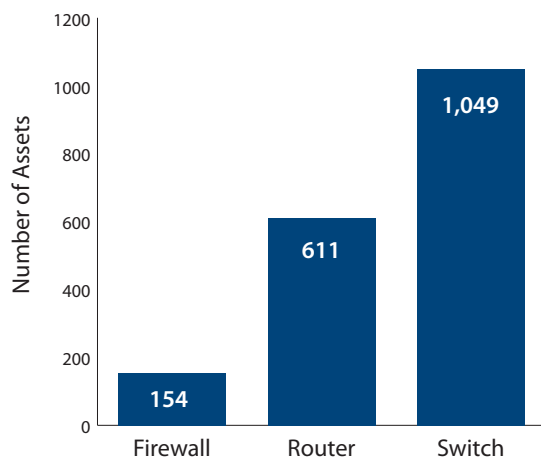


Commentary: WAPA Headquarters has one battery.

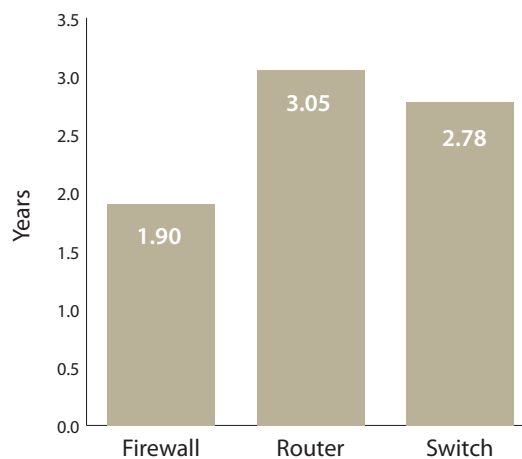


NETWORK EQUIPMENT

Equipment by Type



Average Remaining Service Life



Commentary: Information technology equipment is considered a WAPA-wide asset. For this asset class, data regarding the expected end-of-service life is most useful for determining asset health.



Meter relay crews install and commission new relays in a control room at the Davis Substation.

ASSET CONDITION DATA

Asset Management collects data based on the equipment's criticality to WAPA, lead time for acquisition and replacement, its relevance to the asset class and the ability to validate the accuracy of the data. Because of the diverse nature of WAPA equipment and systems, AM may collect different types of data and apply different metrics to determine health and risk for specific assets or classes.

Some asset classes have health and risk scores while others do not, based on the ability to gather relevant data and the criticality of that asset to the power system. A risk score would not be calculated—or needed—for an asset with minimal lead time for acquisition or minimal installation time. The criteria that drive a health score might not be readily available through routine maintenance activities or the consequence of an asset failing might not be substantial enough to warrant a risk score.

The time it takes to collect and organize sufficient data to calculate health and risk scores for new asset classes depends on the complexity of the asset, the number of units in use and previous tracking efforts. Creating a data collection and analysis framework for load tap changers and transformer bushings is a long-term undertaking because the asset data was scattered across WAPA's regions and there was no unified approach to recording it. AM had to seek approval from IT to use a condition assessment application for evaluating transformer bushings. On the other hand, data collection methods already in use for breakers over 100kV could be easily adapted for breakers under 100kV. Much of the data for cranes already existed in the system of record and only needed to be cleaned, normalized and validated. Cranes and breakers under 100kV will be reported this year, while reporting on LTCs and transformer bushings is expected to begin in 2021.



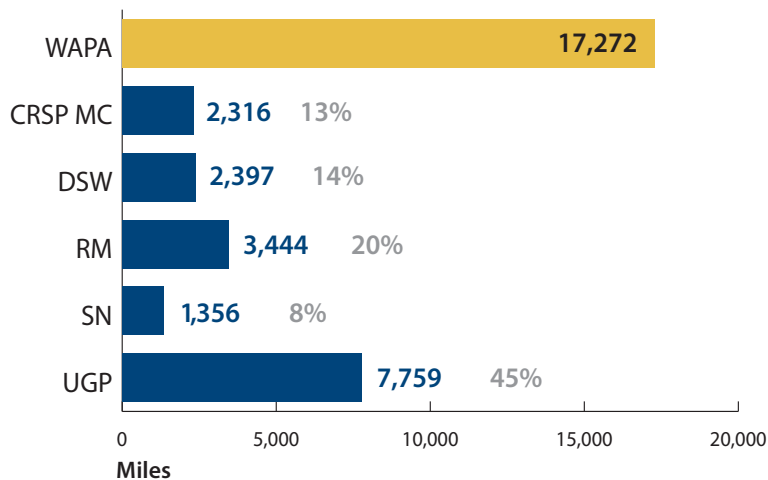
Crews install a 345/230-kilovolt transformer at Liberty Substation. Cranes, which are necessary for many maintenance operations, were added to the Asset Management portfolio in 2020.

TRANSMISSION LINES

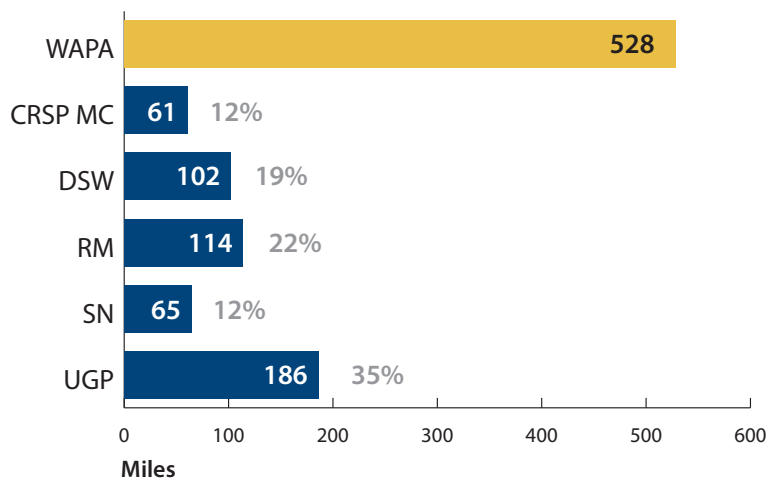
Transmission lines are made up of multiple components and different materials, all exposed to the local elements, and their failure carries serious consequences for WAPA's system. For this reason, Asset Management has moved away from age-based assessments to focus on condition-based data that gives a clearer picture of the line's health and potential for failure. Through routine inspection, performance ratings are assigned to individual structures and components. These ratings drive Health Index algorithms by integrating field knowledge into the overall condition rating of WAPA's transmission line system.

TRANSMISSION LINE ASSETS OVERVIEW

Transmission Line Miles by Region

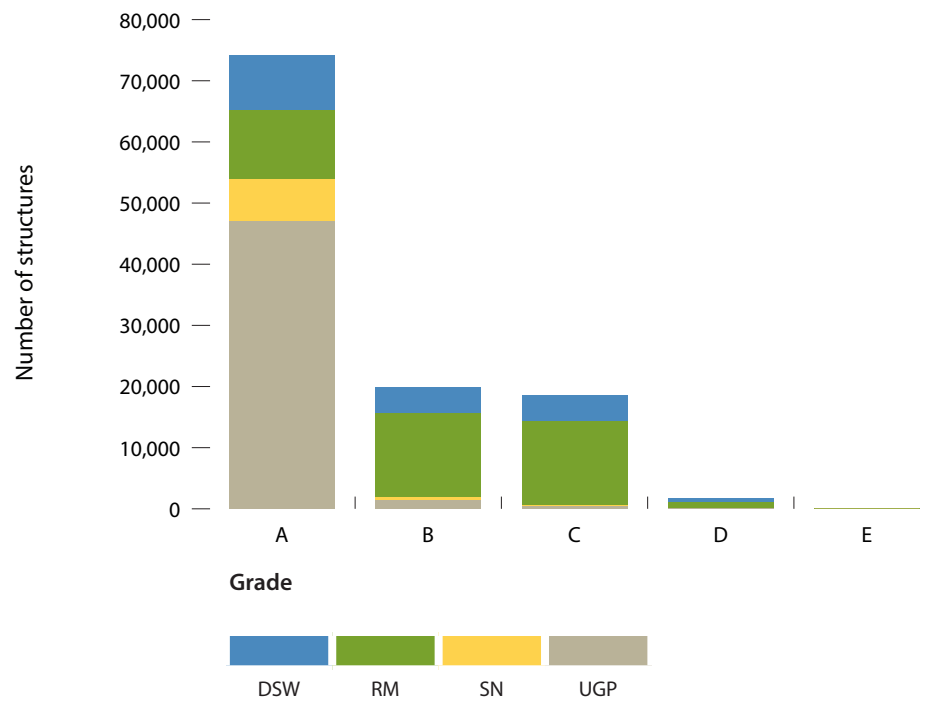


Transmission Line Systems by Region



TRANSMISSION LINE INSPECTION DATA

Transmission Line Structure Maintenance Priority Rating

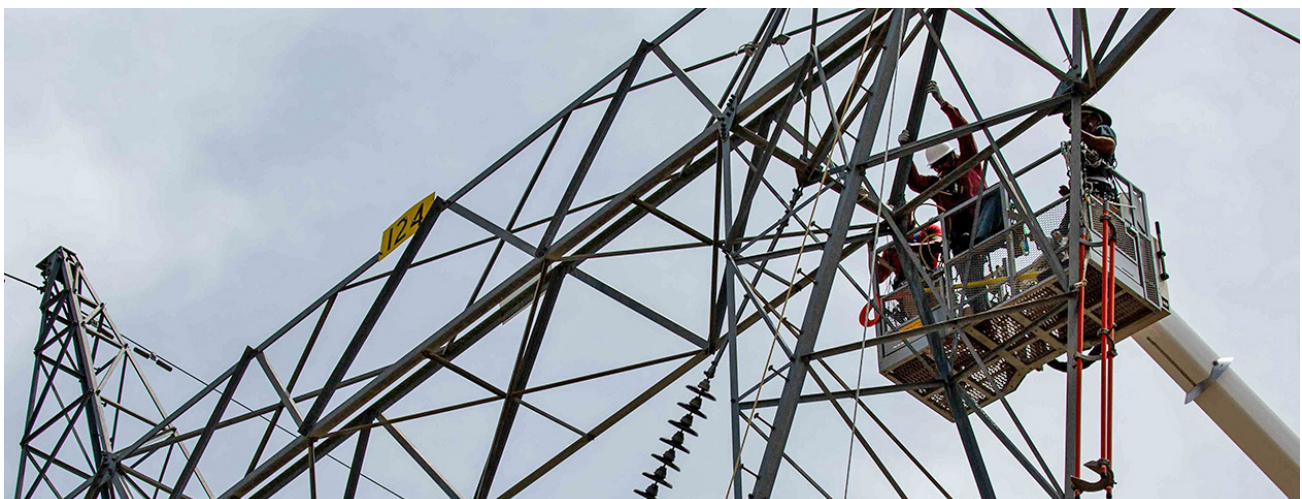


Commentary: Maintenance priority ratings were developed by the Electric Power Research Institute to assign a standardized condition to each transmission line structure or conductor component based on periodic visual inspections, physical test results and age. These ratings, which range from “A” (like new) to “E” (imminent failure), are applied to every component visual inspection.

Definition of each rating is:

- A. Good condition, no action required.
- B. Minimal defect, monitor degradation.
- C. Moderate defect, schedule maintenance.
- D. Severe defect, repair as soon as possible.
- E. Component failed, repair immediately.

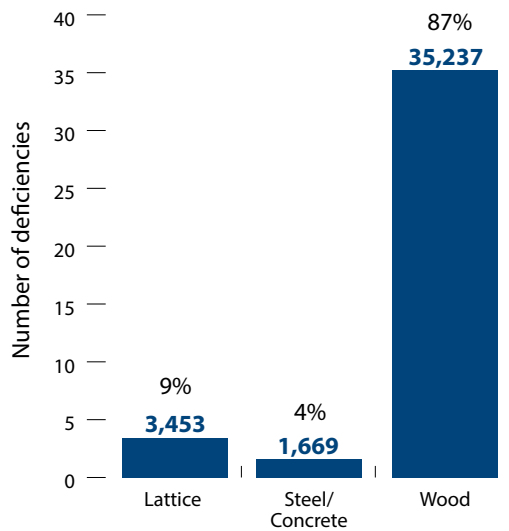
Transmission lines within the boundaries of the Colorado River Storage Project Management Center territory are maintained by Rocky Mountain and Desert Southwest regions.



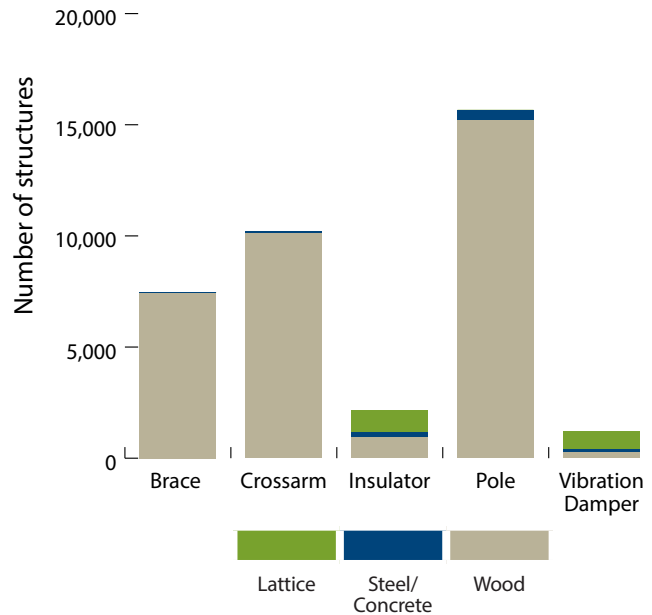
A maintenance crew replaces insulator bells on transmission line. WAPA transmission structures include lattice, steel and concrete and wooden towers.

TRANSMISSION LINE INSPECTION DATA

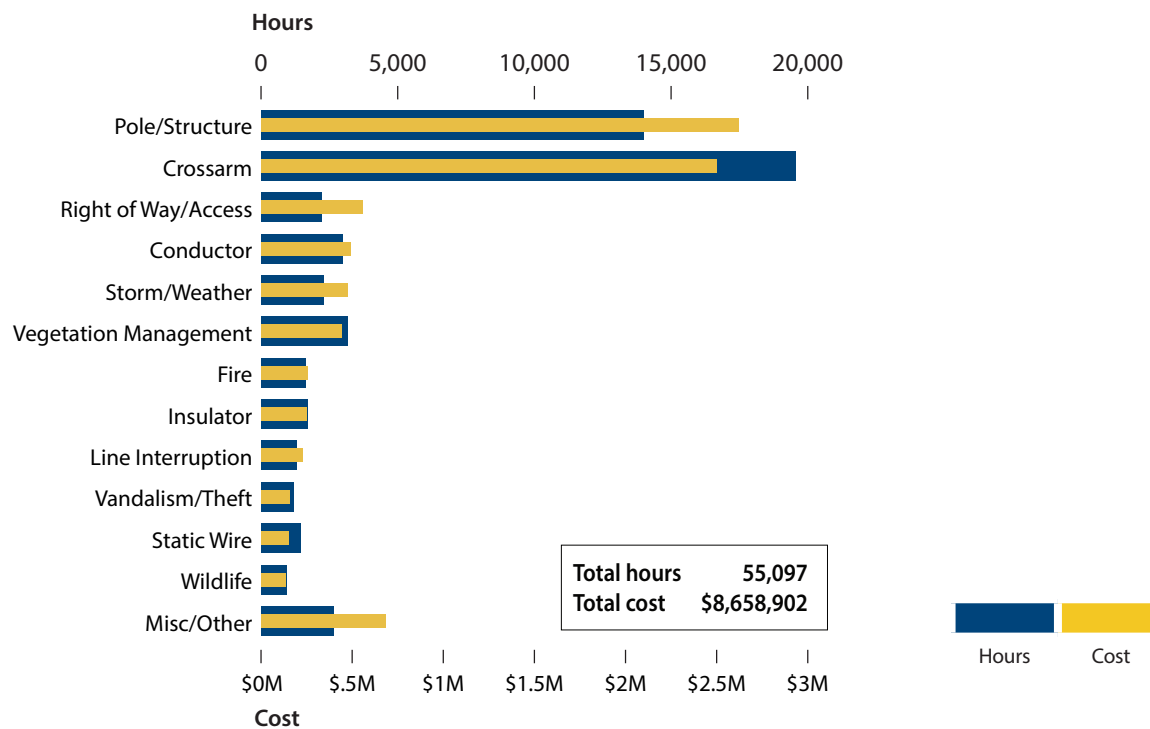
Transmission Line Structure Deficiencies by Material



Transmission Line Structure Deficiencies by Component



Transmission Line Maintenance Items by Cause



Commentary: The data is for reactive, corrective and emergency maintenance work combined for all types of transmission-line structures. It does not include preventive maintenance.

TRANSFORMERS

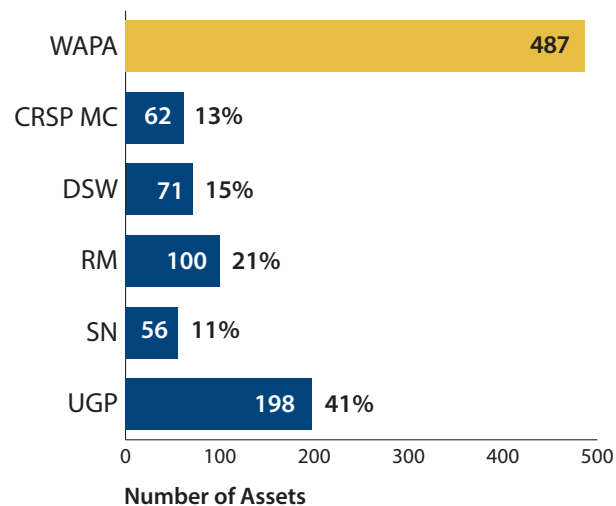
The transformer asset class includes power transformers, grounding transformers, oil-filled reactors and phase-shifting transformers. Single-phase assets are typically considered stand-alone assets when part of a three-phase bank.



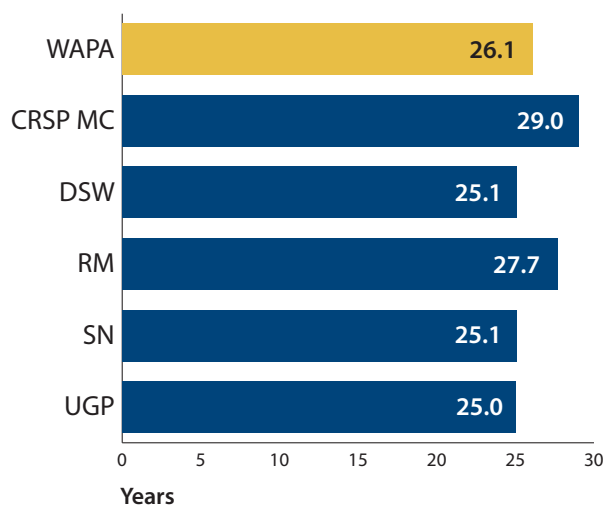
Electricians at Archer Substation perform Doble testing on a large power transformer. Doble testing can detect a variety of conditions that determine the health and risk of transformers.

TRANSFORMER ASSETS OVERVIEW

Transformer Count by Region



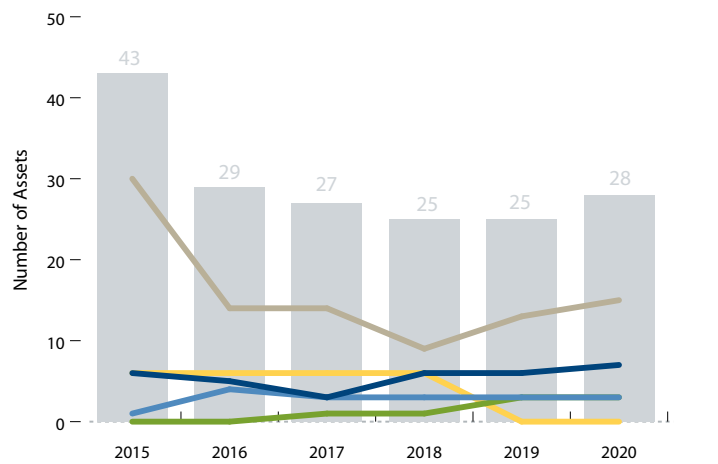
Average Age of Transformers



TRANSFORMER ASSETS: RISK AND HEALTH INDEX OVERVIEW

Trend: Exceeds Risk

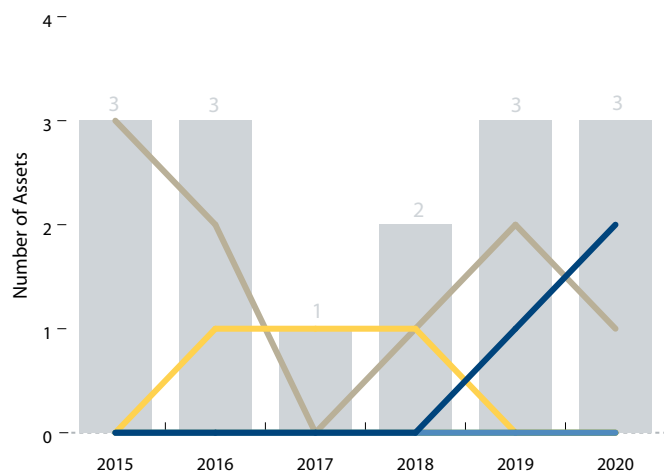
Threshold > 2



Commentary: Transformer risk is quantified by understanding the consequence of asset failure within the transmission system and correlating that to individual health scores.

Trend: Below Health Index

Threshold < 50

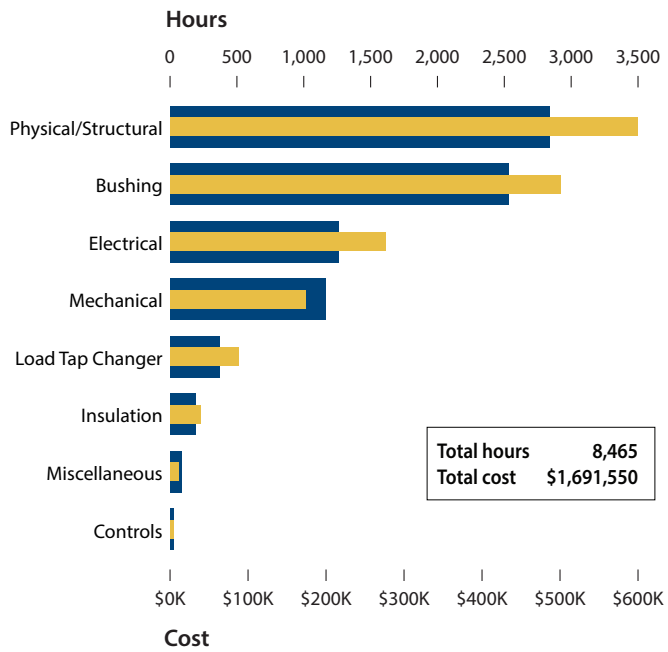


Commentary: The health of oil-filled transformer-type assets is determined by field information gathered on oil condition, operations and maintenance history, electrical condition and age or design factors.

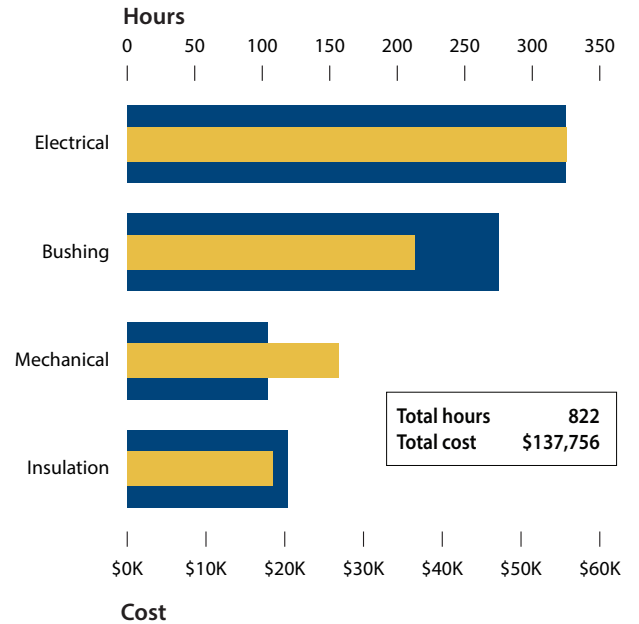


TRANSFORMER MAINTENANCE ITEMS

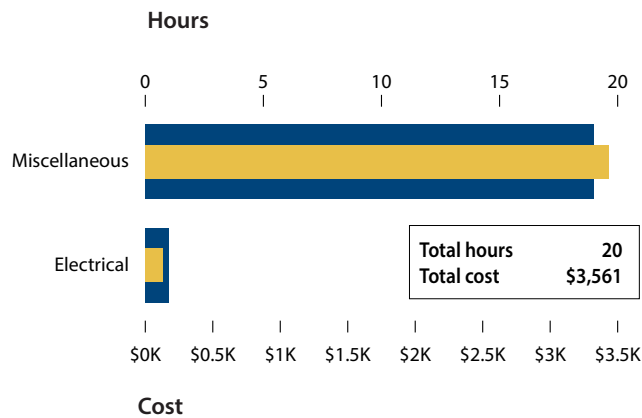
Power Transformers



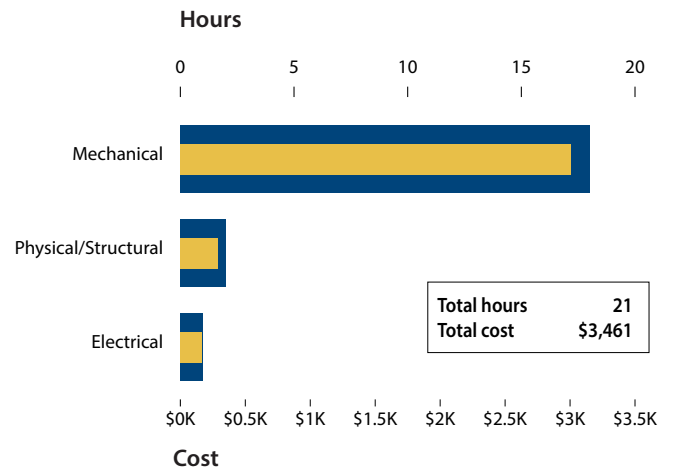
Oil-Filled Reactors



Mobile Transformers



Phase-Shifting Transformers



Commentary: The data is for reactive, corrective and emergency maintenance work combined. It does not include preventive maintenance.



POWER CIRCUIT BREAKERS

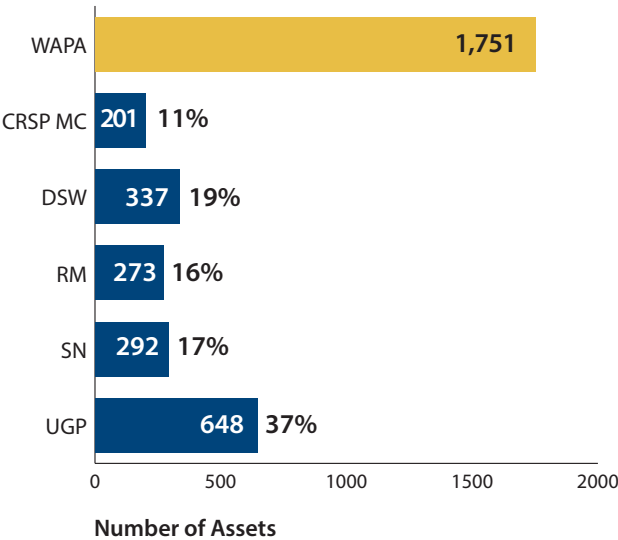
The circuit breaker asset class includes all oil, gas, air and vacuum breakers.



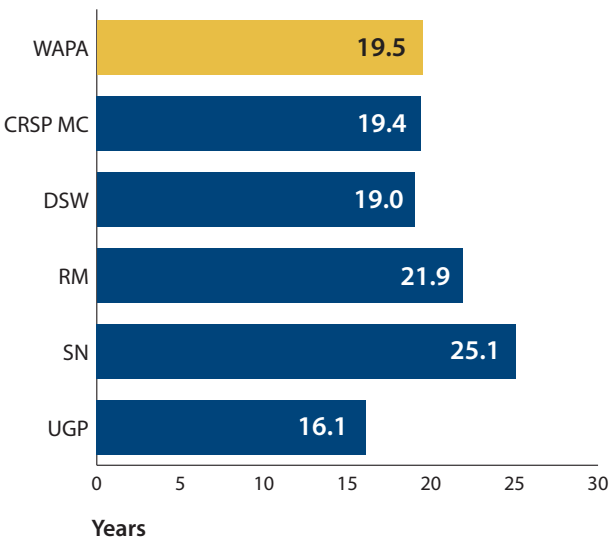
Electricians discuss annual performance testing on a 230-kv gas circuit breaker at Hilltop Substation in WAPA’s Desert Southwest region.

CIRCUIT BREAKER ASSETS OVERVIEW

Breaker Count by Region



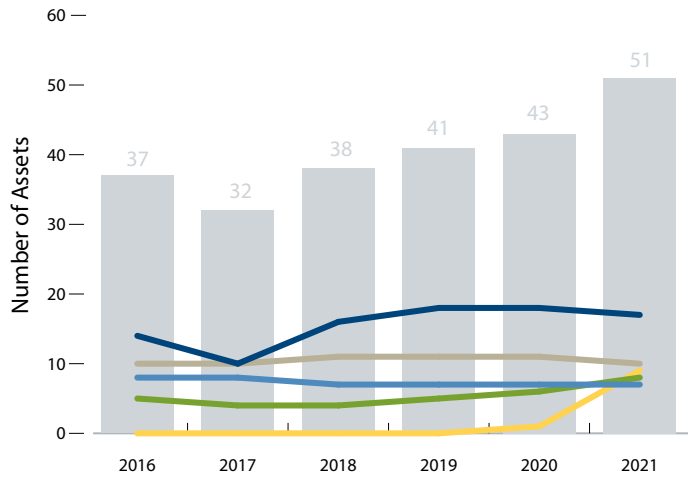
Average Age of Breakers



CIRCUIT BREAKER ASSETS: RISK AND HEALTH INDEX OVERVIEW

Trend: Exceeds Risk

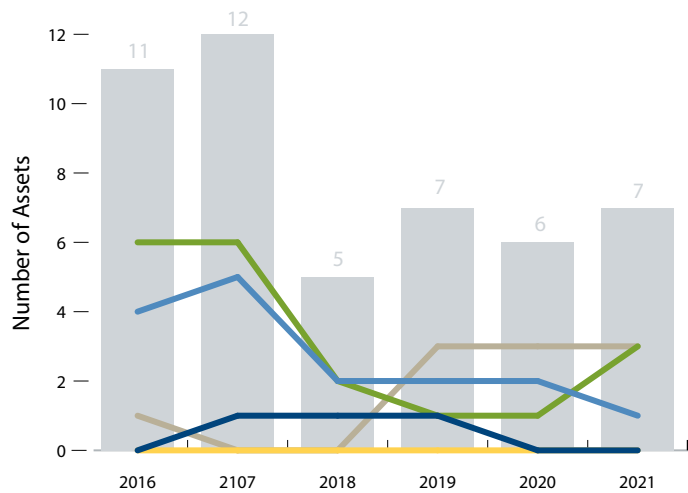
Threshold > 2



Commentary: Power circuit breaker risk is quantified by understanding the consequence of asset failure within the transmission system and correlating that to individual asset health scores.

Trend: Below Health Index

Threshold < 50

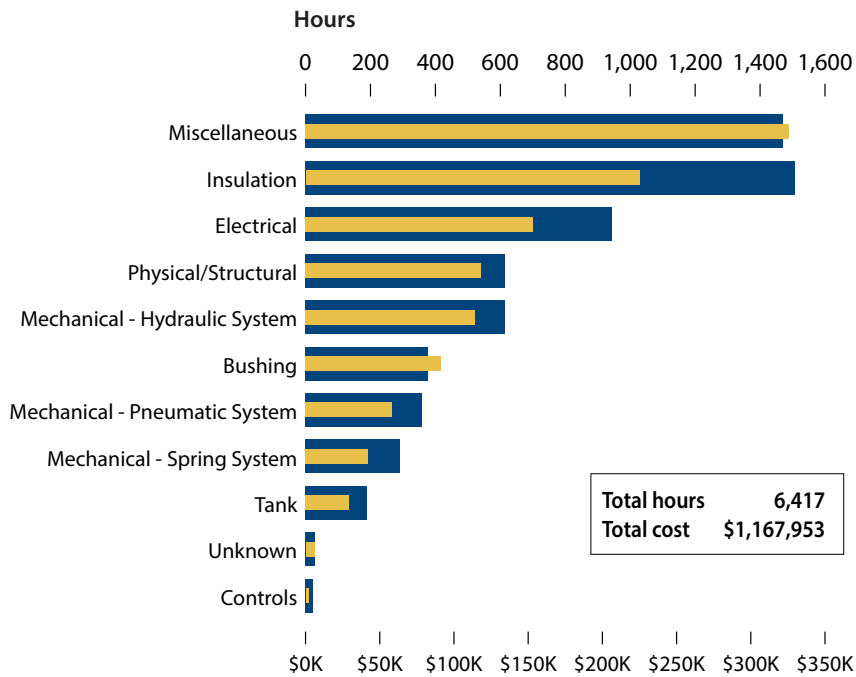


Commentary: The health of power circuit breakers is determined by field information gathered on operations and maintenance history, power system stress, age or design factors and obsolescence.

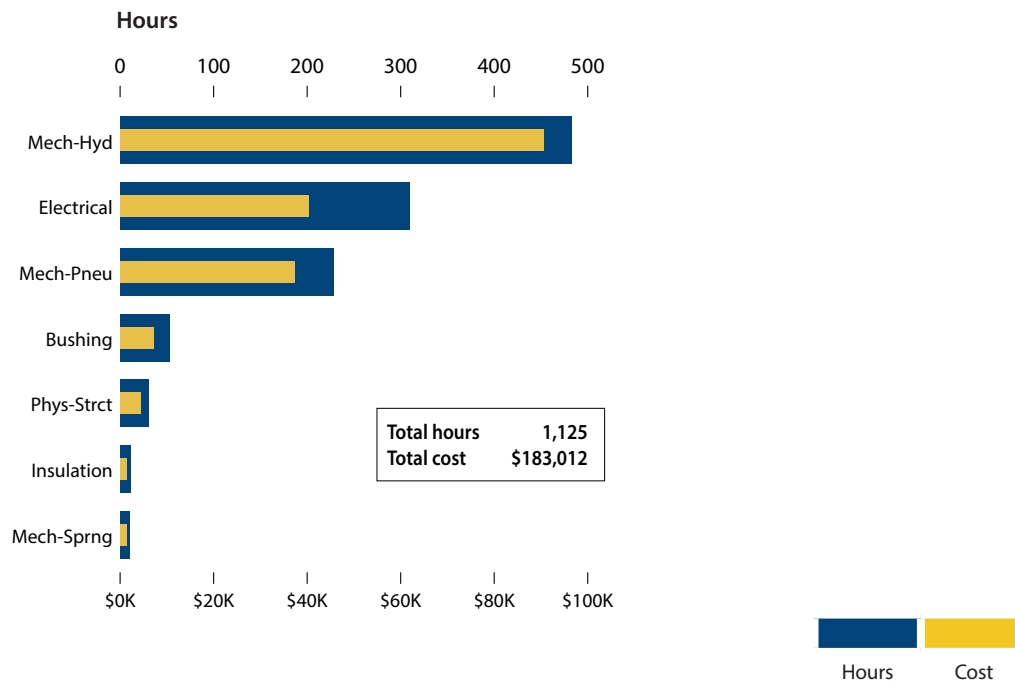


POWER CIRCUIT BREAKER MAINTENANCE ITEMS

Gas Circuit Breakers

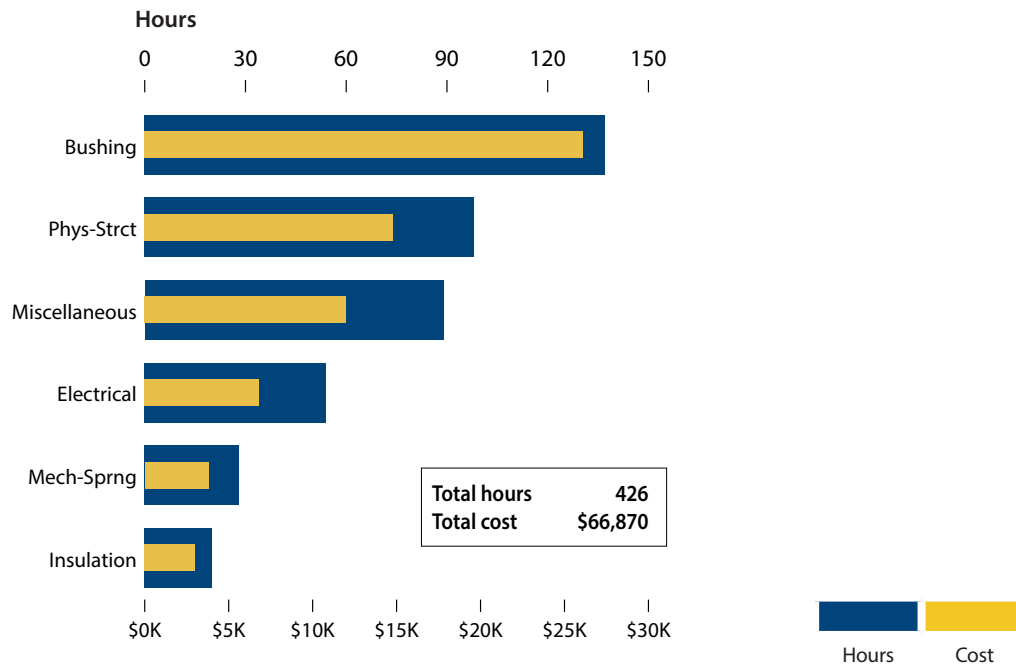


Oil Circuit Breakers



POWER CIRCUIT BREAKER MAINTENANCE ITEMS

Vacuum Circuit Breakers



Commentary: The data is for reactive, corrective and emergency maintenance work combined. It does not include preventive maintenance.

10-YEAR ASSET INVESTMENT PROJECTION

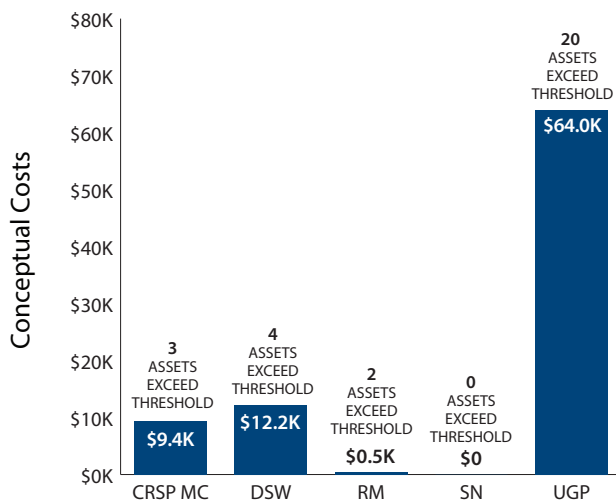
Asset Management developed the WAPA Asset Risk Estimator, or WARE, for 10-year asset investment projections. WARE considers the current known values and gives a projection for which assets will exceed threshold limits over the next 10 years.

AM evaluates existing health and risk thresholds annually based on input from stakeholders and subject matter experts. The thresholds establish actionable boundaries on mitigation for individual assets. Mitigation may include maintenance on the asset to bring it back within threshold, asset replacement or acceptance of risk. The evaluations ensure that the data is validated against the observations and experience of the maintenance crews.

In 2020, the WARE tool was aligned with the AM system of record to produce reports that are easier to read.

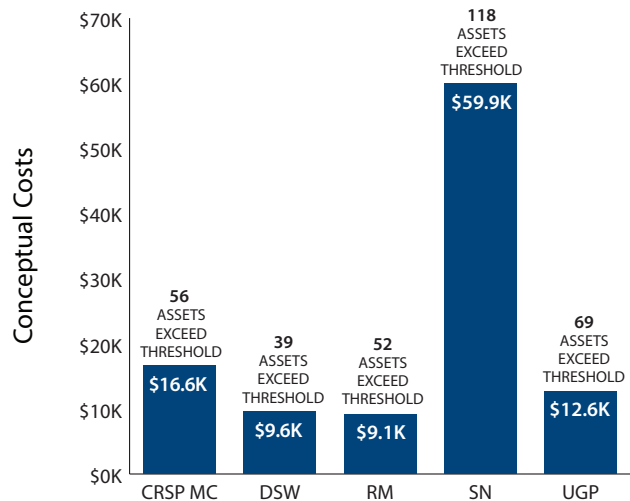
WARE RESULTS: POSSIBLE FUTURE INVESTMENT NEEDS

Possible Transformer Investment: 10-Year Outlook 2021 – 2030



Commentary: The WARE tool projects asset replacement using current health and risk data for the current year, but only uses age data to extrapolate to future years. Mitigation options for assets that fall outside thresholds may include asset investment, replacement, additional maintenance or accepting the risk.

Possible Circuit Breaker Investment: 10-Year Outlook 2021 – 2030



Commentary: The WARE tool projects asset replacement using current health and risk data for the current year, but only uses age data to extrapolate to future years. Mitigation options for assets that fall outside thresholds may include asset investment, replacement, additional maintenance or accepting the risk.

Assets identified by WARE as exceeding thresholds may not necessarily need replacement. Additional maintenance or accepting risk are options for mitigation.

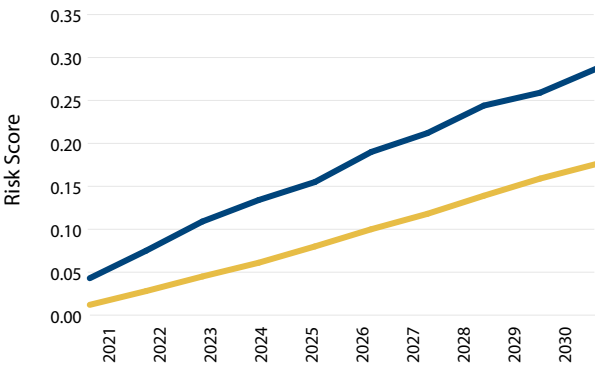
10-YEAR HEALTH AND RISK PROJECTION

Assets that fall outside of the established health and risk thresholds are identified for mitigation actions.

The graphs below show a projection of health and risk values for the respective assets if current thresholds are maintained.

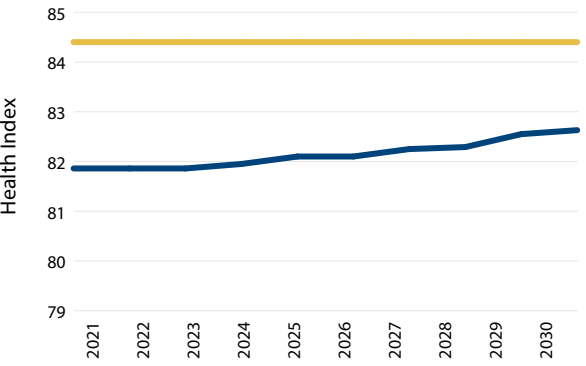
RISK AND HEALTH INDEX FORECAST

Transformer Risk Score Forecast



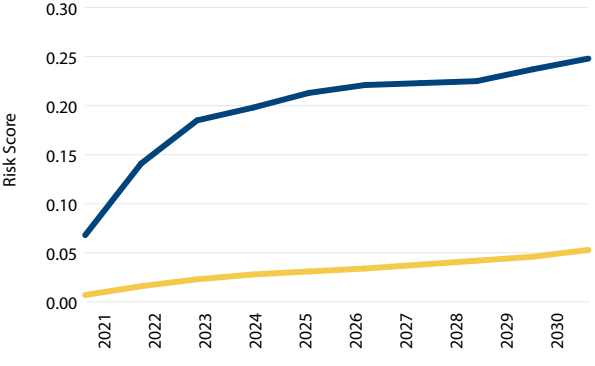
Commentary: If the current risk thresholds remain at current set points, risk scores trend upwards. Reducing the current thresholds may be a solution to the climbing trend.

Transformer Health Index Forecast



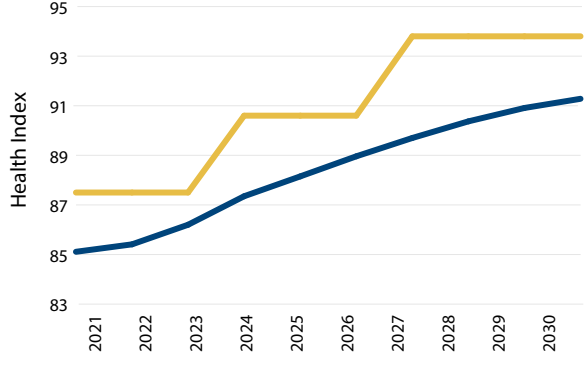
Commentary: Health forecasts remain steady and no adjustments to thresholds may be necessary.

Breaker Risk Score Forecast



Commentary: If the current risk thresholds remain at current set points, risk scores trend upward. Reducing the current thresholds may be a solution to the climbing trend.

Breaker Health Index Forecast



Commentary: Health forecasts remain steady and no adjustments to thresholds may be necessary.



RELIABILITY-CENTERED MAINTENANCE

Reliability-centered maintenance, or RCM, is a systematic approach to developing an optimal maintenance strategy that focuses on preserving important power system equipment functions. Maintenance crews collect data as part of WAPA's RCM program to lay the foundation for effective maintenance planning and management as well as justification of maintenance decisions.

This focus on maintenance strategy makes the program a valuable resource when adding assets to the AM portfolio or improving the data collection process for assets already in the AM system. In 2020, RCM took the lead on establishing load tap changers as a separate asset class, verifying the LTC population, collecting “low-hanging” data, coordinating the creation of record-keeping tools and determining technical specifications. One in five WAPA transformers and reactors have LTCs, and the component is a common transformer point of failure. RCM insight is central to developing a reporting strategy that preserves the functioning of this critical transmission system component.

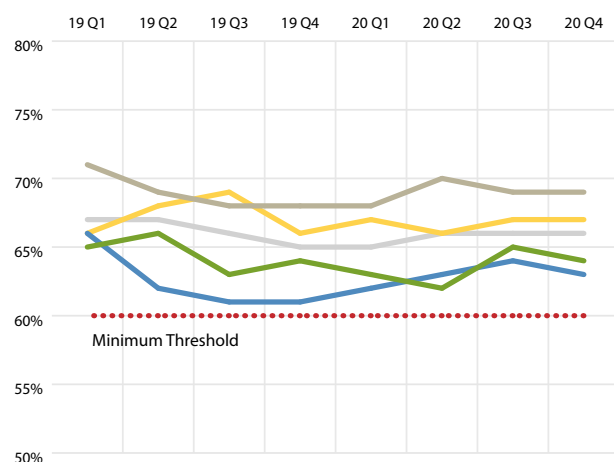
The RCM team also collaborated with the Montana Maintenance Office in WAPA's Upper Great Plains region to increase the efficiency of preventive maintenance on power circuit breakers. Leveraging mobile devices and software platforms currently used to perform substation inspections, the pilot project successfully automated several manual steps. The electronically captured inspection data saves time and paperwork, centralizes data storage in the system of record and enables maintenance to trend data over time. The method can easily be modified to accommodate nearly half of WAPA's breaker fleet and is ready to be rolled out WAPA-wide in the coming year.



Linemen drive many miles to conduct inspections on transmission lines in WAPA's 15-state footprint. This 115-kV transmission line in eastern Colorado required corrective maintenance to repair a conductor that failed due to a splicing issue.

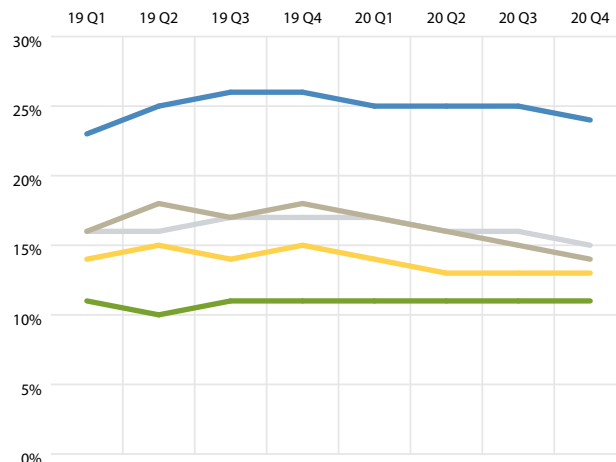
CREW HOURS OVERVIEW AS OF FYE 2020

Percent Direct: 2-Yr Trend of the 4-Qtr Moving Average



Commentary: This graph represents the percentage of time crews in each region and WAPA as a whole perform direct work on WAPA assets, also known as wrench time. Wrench time includes preventive, reactive, corrective and emergency maintenance; construction; minor additions, enhancements and retirements; and operations support. AM established the goal of 60% or more crew time for direct work based on industry benchmarking. Maximizing crew time for performing direct work is a measure of resource management effectiveness. Rocky Mountain and Desert Southwest regional Maintenance organizations maintain the assets of the Colorado River Storage Project Management Center (approximately 12% of WAPA's major assets), which are included in the graph.

Percent Administrative: 2-Yr Trend of the 4-Qtr Moving Average

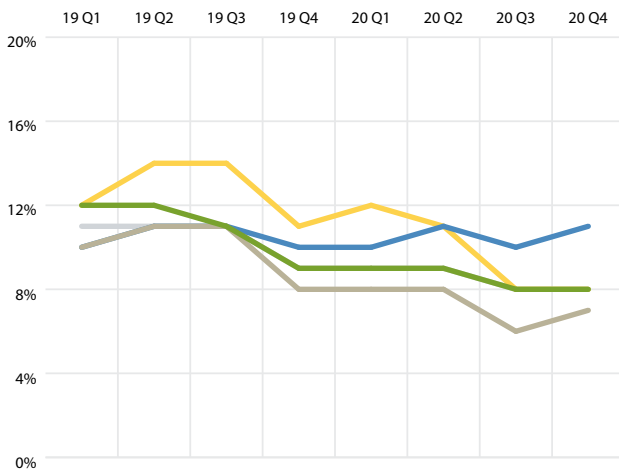


Commentary: This graph represents the total percentage of time crews in each region and WAPA as a whole perform administrative duties. Administrative duties include work activity such as drawing updates, general engineering support, credit-card reconciliation and timekeeping. Training and compliance activities such as training, attending meetings, union activities, safety and security investigations and environmental inspections are also in this category. Although no official goal has been established, 25% or less is considered acceptable due to the amount of training and compliance activities (safety, environmental, North American Electric Reliability Council, Western Electricity Coordinating Council, etc.) mandated for maintenance Craft teams. Minimizing administrative duties of Craft personnel results in better use of the employee skillset. Administrative work is tied to maintenance organizations rather than specific assets.



CREW HOURS OVERVIEW AS OF FYE 2019

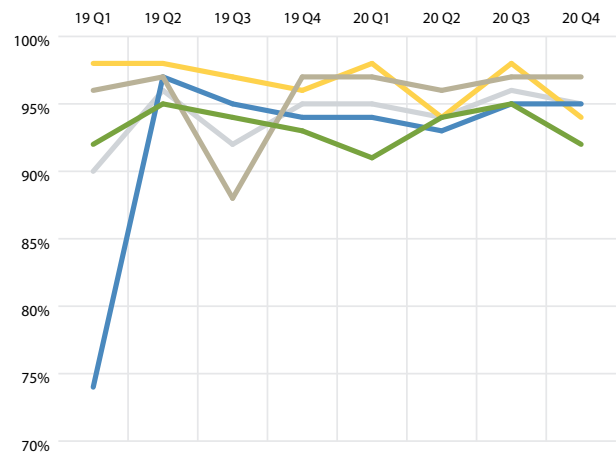
Percent Overtime: 2-Yr Trend of the 4-Qtr Moving Average



Commentary: This graph represents the total percentage of time crews in each region and WAPA as a whole perform work while in overtime. Although there is no set goal for this metric, tracking percent overtime gives a fair indication of resource (personnel) needs and system health. An excess of scheduled overtime indicates the need for more full-time employees, while excessive unscheduled overtime suggests problems with system health as emergency-type work often occurs during typically non-working hours (overtime). RM and DSW regional maintenance organizations maintain CRSP MC assets (approximately 12% of WAPA's major assets), which are reported with these regions in the graph.



Percent RCM: 2-Yr Trend of the 4-Qtr Moving Average



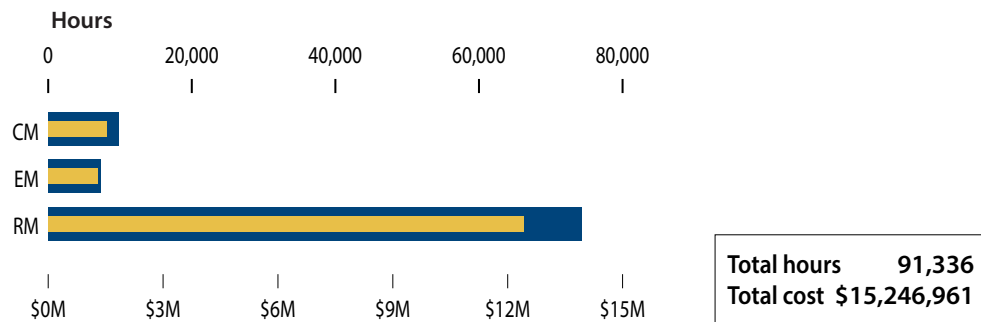
Commentary: This graph measures WAPA's ability to maximize preventive and reactive maintenance work (typically a planned follow-up to issues discovered during preventive maintenance) over corrective and emergency maintenance and is a key performance indicator for WAPA's RCM program. There are no industry standards published for this metric; however, WAPA has established its own standard based on historical data gathered over the past 15 years. Reactive maintenance that represents 90% or more of maintenance work indicates a successful RCM program. Falling below that threshold triggers an action plan to address program improvements. RM and DSW regional maintenance organizations maintain CRSP MC assets (approximately 12% of WAPA's major assets), which are included in the graph.

REACTIVE, CORRECTIVE AND EMERGENCY MAINTENANCE CATEGORIES AND COSTS

Maintenance-related work orders fall into four categories:

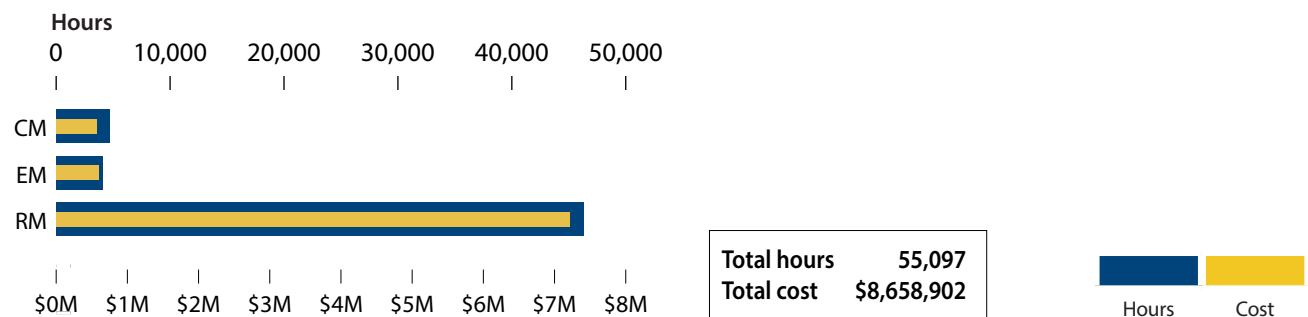
- Preventive maintenance is planned work intended to predict, prevent or detect asset and component failure or progression to failure. This work at WAPA is based primarily on time intervals but can also be determined by counter readings, system events or asset condition.
- Reactive maintenance occurs when PM or a remote indicator alarm uncovers a degraded condition on a functioning asset that can be mitigated before the asset's function fails. Since the asset is still functioning as intended, the repair can be planned and scheduled.
- Corrective maintenance fixes a problem that has caused an asset to fail in its intended function. This type of failure is not detected through PM or alarm indication, making unplanned repairs necessary to restore the asset to functionality. It differs from emergency maintenance in that the problem, while imminent, does not require immediate attention. Corrective maintenance is typically follow-up work to emergency maintenance.
- Emergency maintenance mitigates a sudden disruption of the power system or other emergency condition and either restores unexpected loss of essential functions or mitigates the emergency condition. EM warrants cessation of other assigned work and may result in sending crews out after hours. While EM focuses on immediate restoration or mitigation measures, CM work typically follows EM to repair the item that caused the emergency condition.

Overview of RM, CM, EM Hours and Cost



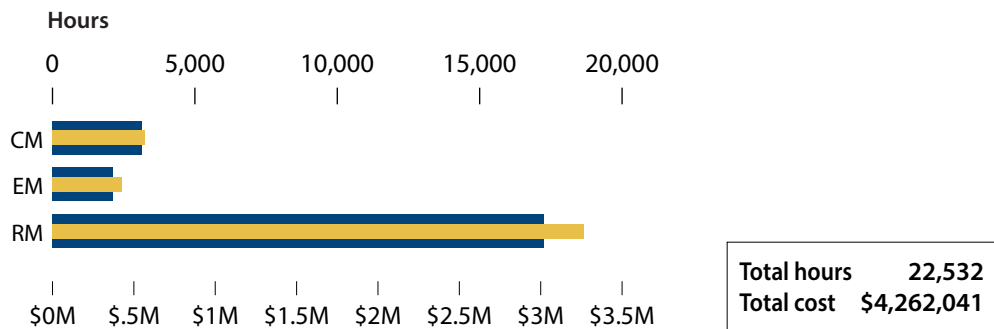
Commentary: This graph represents the total dollars and hours WAPA spent performing RM, CM and EM work outside of planned preventative maintenance on all equipment for calendar year 2020. Transmission lines, substation equipment, transformer-type equipment and power circuit breakers represent a portion of WAPA's total equipment assets.

Transmission Line RM, CM, EM Hours and Cost

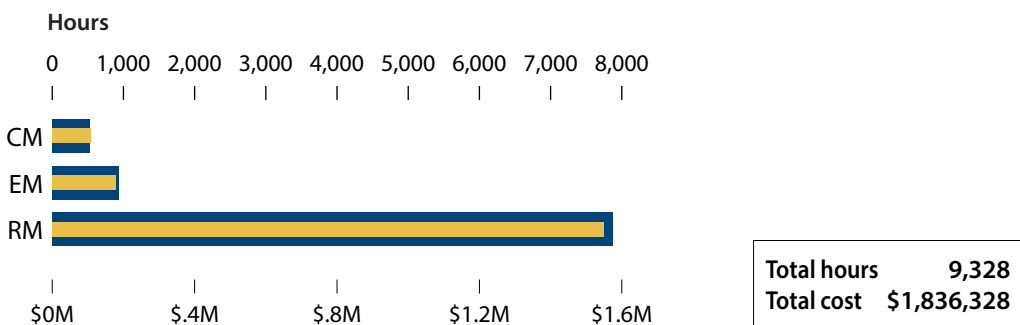


REACTIVE, CORRECTIVE AND EMERGENCY MAINTENANCE CATEGORIES AND COSTS

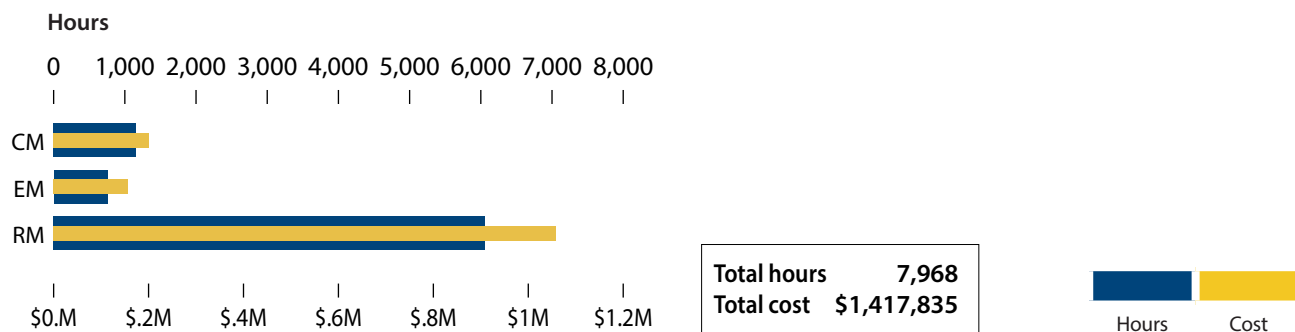
Substation Equipment RM, CM, EM Hours and Cost



Transformer-Type Equipment RM, CM, EM Hours and Cost



Power Circuit Breaker RM, CM, EM Hours and Cost

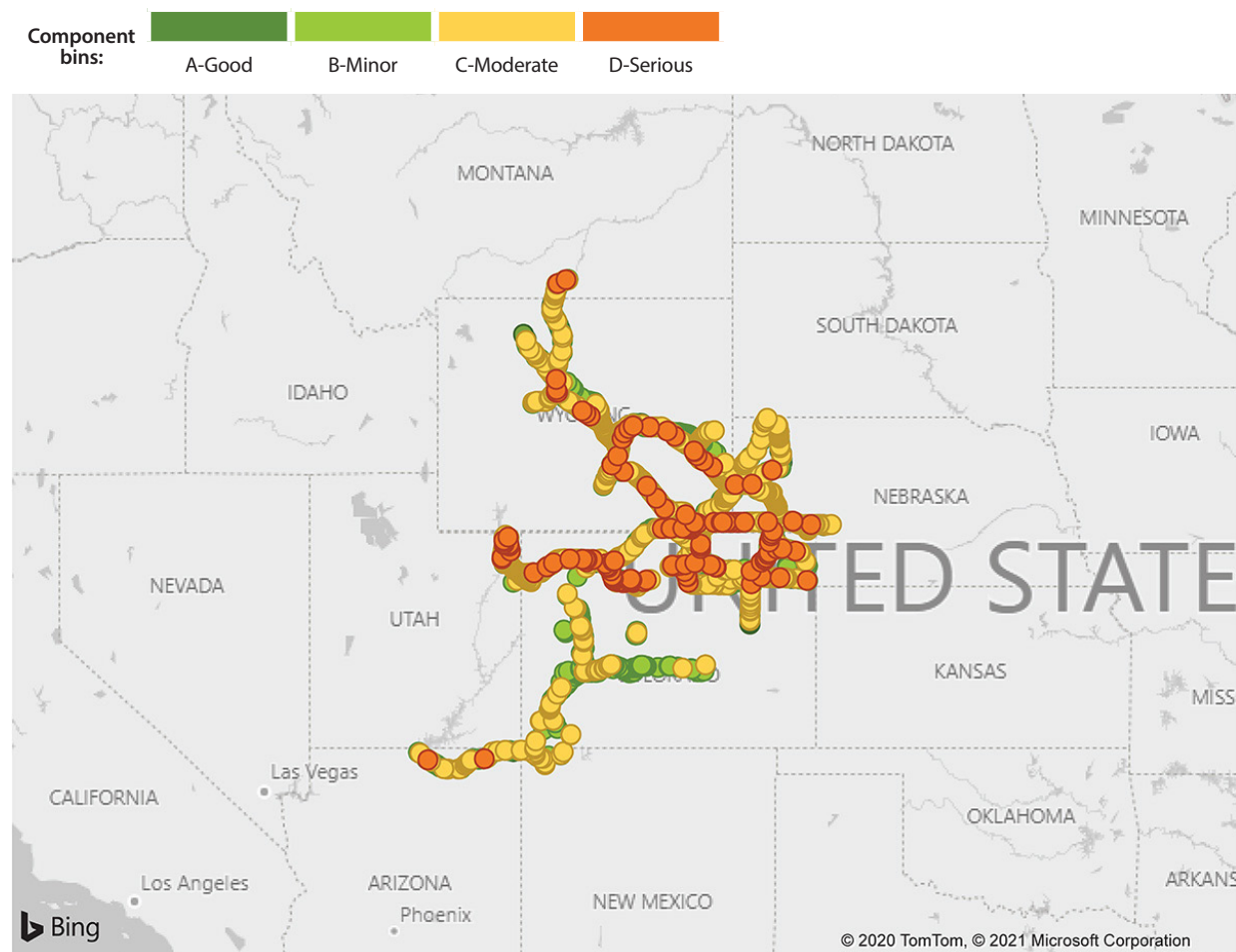


DATA COMMUNICATION

As WAPA business units have increasingly adopted AM products for decision making, developing more accessible reports has become a significant part of outreach efforts. In 2020, AM began converting tabular Excel spreadsheet reports to more user-friendly visual presentations in Power BI. The detailed, interactive maps created by this software allow users to drill down to relevant data they can understand—and apply—at a glance.

This change is putting more valuable asset data in front of decision makers throughout WAPA, from crews who install and maintain electrical assets to financial planners who guide WAPA's capital investments. Internal stakeholder groups include:

- Senior Leadership Team.
- Regional rate-setting organizations.
- Financial Leadership Council.
- Power Marketing Management Council.
- Power System Operations Council.
- WAPA Maintenance Management Council.
- Information Technology Senior Leadership Team.
- Acquisition Collaboration Team.
- Regional Asset Management specialists.
- Regional capital planning groups.
- Administrative Services Council.



This Power BI chart provides a snapshot of transmission line component data in WAPA's Rocky Mountain region. The visual summarizes the overall health of RM's transmission line structures and the rating of each component. Users can select a specific transmission line system or structure and see the health index scores for each component, color coded by its maintenance rating.

WAPA's leadership in promoting asset management strategy in the electricity industry includes sharing AM reports with outside stakeholders, including:

- Customers and regional and membership groups representing them.
- North American Transmission Forum.
- Electric Power Research Institute.
- Regional capital planning groups.
- Technical committees.
- Engineering and operating committees.

DATA VALIDATION

AM's validation process treats data as a strategic asset by applying standardized management practices, enforcing rules surrounding data use and establishing consistent criteria for data acceptance. As this methodology gains acceptance across WAPA, the data in AM reports will increase in quality and reliability.

To ensure data accuracy and reliability, AM validates data in two ways:

- Quantitatively – Reports on incorrect and missing data are prepared monthly to identify gaps in asset data that may be skewing asset health or risk scores.
- Qualitatively – Knowledgeable field crews corroborate asset management data as needed to ensure asset scoring is representative of actual field conditions.

The Data Quality Confidence Index pilot carried out in 2020 examined the methodology AM uses to validate the reliability of Health Index scores produced by the record-keeping system. Using gas breakers as the sample asset, AM analysts aligned the weight given to datapoints used in calculating both the asset HI and its confidence score. Bringing consistency to weighting ensures that the factors most important in determining the HI get the same consideration in measuring the trustworthiness of the HI.

Regional Asset Management specialists have provided feedback on the value of weighting system and project results. The adjusted framework is now ready to present to the WAPA Maintenance Management Council and incorporate into the record-keeping system. Additional assets will be phased into the framework over time.

CONTACT AM

Asset Management Program
Western Area Power Administration
www.wapa.gov/About/Pages/asset-management
Chris Lyles, VP of Asset Planning and Management
720.962.7249
lyles@wapa.gov



Western Area Power Administration

WESTERN AREA POWER ADMINISTRATION
P.O. Box 281213
Lakewood, CO 80228-8213
www.wapa.gov



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